Multifractal Detrended Fluctuation Analysis

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1 MULTIFRACTAL DETRENDED FLUCTUATION ANALYSIS

In time series analysis, detrended fluctuation analysis (DFA) is a method for determining the statistical self-affinity of a signal. It is useful for analysing time series that appear to be long-memory processes. Several techniques have been developed to carry out this separation. Among these are, de-trended fluctuation analysis and its variants and the wavelet transform based multiresolution analysis

2 ANALYSIS OF EXPERIMENTAL DATASETS

Experimentally obtained time series of V_2O_3 resistance at different temperature was measured using a lock in amplifier. Data was obtained while cooling of V_2O_3 sample from 200K to 77K. Resistance-Temperature curve of the sample shows a metal-insulator transition around 150 K. Time series of the resistance were measured at both metallic and insulating region. Each time series has around 24000 data points sampled at 14.5Hz.

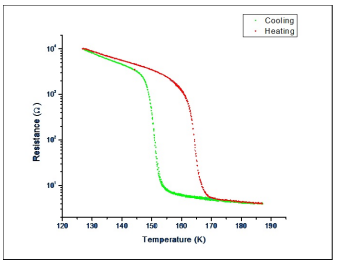


Figure 2.1: Resistance-Temperature plot for V_2O_3

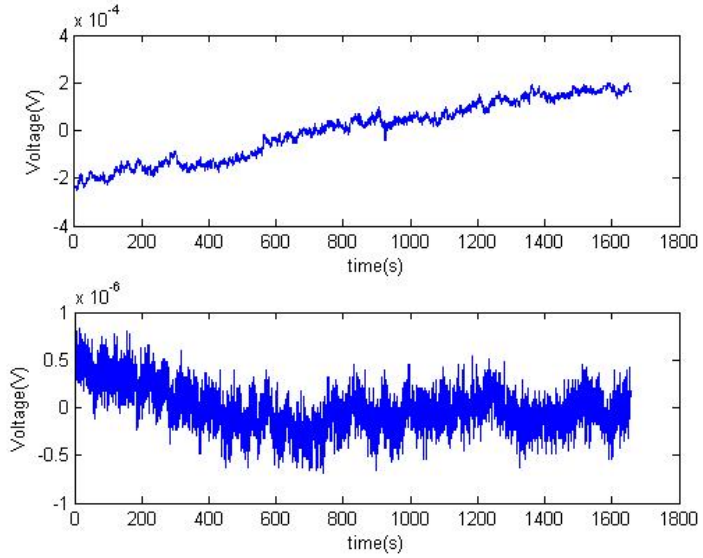


Figure 2.2: Time series with subtracted mean at (a) Voltage at insulating phase T=149K (b) Voltage at conducting phase T=165K. Each time series is of approx. 24000 data points

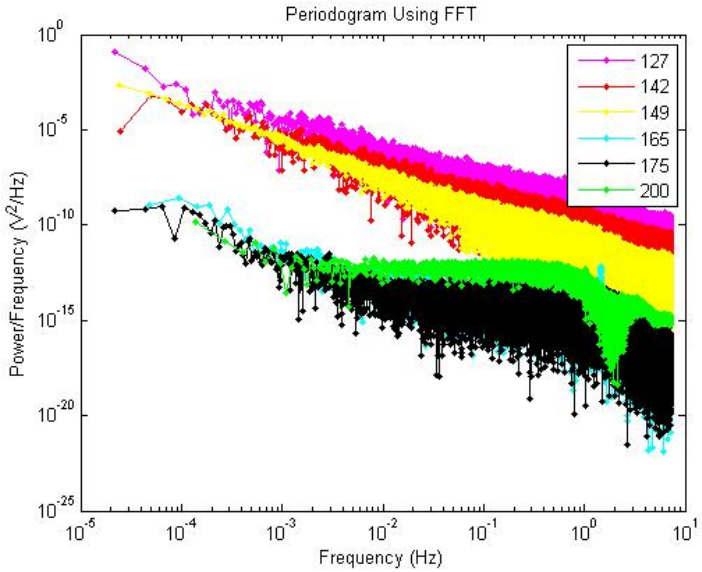


Figure 2.3: Power spectrum of the time series data for different temperatures ranging from 125 K to 200 K

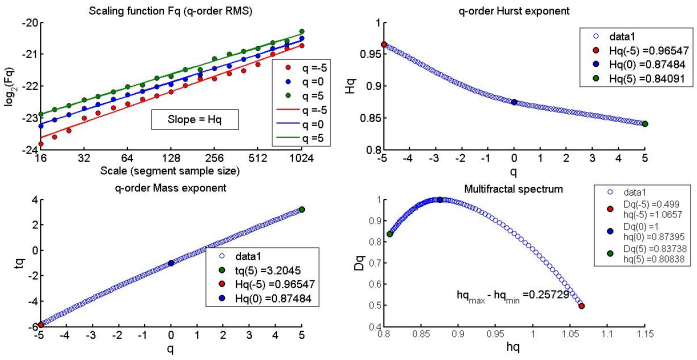
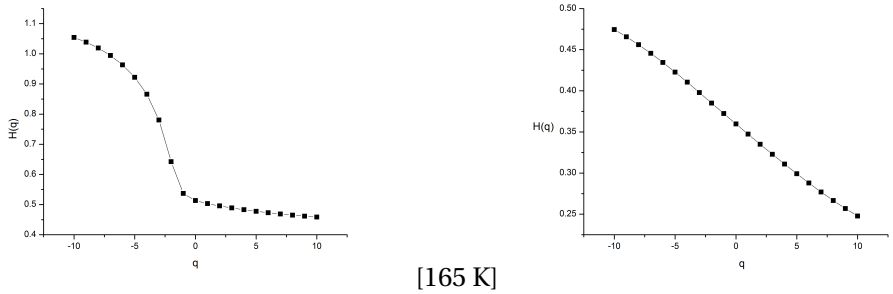


Figure 2.4: (a) log-log plot of fluctuation Fq(s) vs scaling for various values of q of time series voltage data at 149K . (b) Hurst exponent Hq vs q (c) Mass exponent vs (q)



[149 K] [165 K]

Figure 2.5: For time series [b] above Tc, h(q) shows linear behavior for different values q, indicating a monofractal behavior and [a] the non-linear behavior of h(q) for different values of q at Temperature< Tc (T=149 K), shows clearly the long-range correlation and multifractal nature.